**CH 6 Chemistry of Life**

**Metabolism-** All chemical reactions in an organism

**Atoms -** smallest unit of matter, nondivisible by chemical means

**Element**  *-*any substance that contains just one type of atom

1-92 are natural- except for 43 & 61: 93 and higher are synthetic

**Trace Elements-** found in very small amounts but are vital in maintaining health

**Nucleus:** central unit

* 1) Protons: positive charge protons number =*atomic number*
* 2) Neutrons: no charge
* sum of protons + neutrons = *atomic weight)*

**Electrons:** negative charge

* 1) In electrically neutral atom, # of protons=# of electrons
* 2)found in shells, levels or cloud
* 3) Greatest amount of energy is in shells farthest from nucleus.
* 4) First shell contains up to two e-thereafter up to eight e- in the outside shell

1. **Isotopes** -atoms with same number of protons & electrons but different in number of neutrons & therefore weight ! Examples: 14C an isotope of 12C -may be radioactive Uses: biological research, medical diagnostic procedures

**Octet rule-** Perfect # of e- in outside shell=8

Atoms react with one another in order to achieve eight electrons in their outer shell.

**Ions-** Atoms may gain or lose electrons to become more stable.

* **Anions**- (negative ions) gain electrons
* **cations**- positive ions- lose electrons

**Compound**- two or more atoms of different elements combine together. Chemically combined with different properties ex. NaCl

**Molecule:** smallest part of compound that still has properties of that compound.; no

charge; has a chemical formula ex. H20

**Solution-**Occurs when one substance is evenly distributed in another substance

Occurs in all forms; ex. Gas in a liquid- etc.

**Mixtures-** A combination of substances where they retain their own properties

**Ionic Reactions-** chemical reaction in which positively and negatively charged ions are formed when (an) electron(s) is (are) transferred from a metal to (a) nonmetal(s). *Ionic bond* forms when oppositely charged ions are attracted to each other. Ex Na + and CI-

**Ionic Bond-** Forms when electrons are transferred from one element to another to become more stable.Atoms have filled outside shells (8):Joins a metal and a nonmetal

**Covalent Bonds**- Occur when elements share electrons; Atoms combine to become more stable; ex. Sugars, fats, proteins + water

**Covalent Reactions**- occurs when nonmetals react with nonmetals in which electrons are shared so that each atom will have a complete outer shell.

* Double bonds: Two pairs of electrons are shared between atoms;
* Triple bond has three pairs of electrons shared.

**Oxidation-Reduction-** occur concurrently

* **a**. Oxidation: For ionic reactions, it refers to loss of electrons:
* For some covalent reactions, it refers to loss of hydrogen atoms.
* **b.** Reduction: For ionic reactions, it refers to gain of electrons:
* For some covalent reactions, it refers to gain of a hydrogen atom.

***Organic compounds-***always contain carbon & hydrogen, have covalent bonding, may be quite large and are often associated with living organisms.

***Inorganic compounds****-* usually contain metals and nonmetals, usually have ionic bonding, have a small number of atoms, associated with nonliving elements.

**Water-** a polar molecule from a covalent bond where the e- are not shared equally; has a weak hydrogen bond; makes up 70-90% of most organisms**.**

**Water Properties**

* **absorbs & releases heat slowly**
* **acts as solvent**
* **dissolves other polar substances**
* **Liquid water is more dense than ice (ice therefore floats).**
* **High surface tension**
* **capillary action**

Reactions depend on; **Temperature, Energy Availability, Concentration, pH**

**Acids: compounds that form H atoms in water and release (protons)- ex. HCl**

**Bases: compounds that form hydroxide ions (OH) in water Ex., NaOH**

**pH-** used to indicate acidity and basicity of a solution.

* pH < 7 is acidic ; pH > 7 is basic ; pH 7 being neutral.
* Each unit in the pH scale ; has a tenfold difference in H + concentration

**Buffer-** a chemical that can take up excess Acid (hydrogen ions) or excess hydroxide ions; prevents large changes in pH of a solution. helps keep blood pH constant.

**Salts-** results when an acid reacts with a base; ex.HCl + NaOH -> Na + Cl + HOH

**Diffusion-** Movement of particles from an area of higher concentration

Brownian movement- random movement of particles affected by temp & pressure

**Dynamic equilibrium**- No overall concentration change, but are evenly distributed- same # moving in both directions

**Isomers-** Hexoses- all of these have same molecular formula, C6H1206 but a different 3-D structure; glucose-primary energy source ; fructose (in fruits); galactose (in milk);

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**Polymer-** A large molecule formed when smaller molecules (monomers) bond together - usually in long chains.

**Carbohydrates- monosaccharides combine** Simplest sugar; Store and release energy

1. carbohydrate loading- eating starchy foods the day before a race, etc.

Carbohydrates-Monosaccharides

1. Condensation- two monosaccharide units joined together with water removed (dehydration synthesis)
2. Hydrolysis- water splits polymers

Carbohydrates: Sucrose- (table sugar) a glucose and a fructose unit joined together

* Carbohydrates: Polysaccharide; many monosaccharide units joined together
* a) Starch: storage form of glucose in plants
* b) Glycogen: storage form of glucose in animal cells
* Carbohydrates: Polysaccharide
* c) Cellulose: in plant cell walls; provides strength. We are unable to digest cellulose in our digestive tract.

**Lipids -** organic compounds that are insoluble in water

* a) Fats-(solid at room temp.) (triglycerides
* b)oils (liquid at room temp.) Function: long-term energy source, insulation, major component of membranes. in adipose tissue Beef Fat- C57H110O6

**Lipids: Glycerol & fatty acids combine**: Three fatty acids: may be *saturated or unsaturated ;* depends on double bonds)-accounts for liquid nature of vegetable & oils ; Soaps; salts formed by a fatty acid and an inorganic base. ;They are used to *emulsify* (disperse) fats and oils in water

**Lipids: Phospholipids-**  Function: important in cellular membranes

Ex. Steroids ; four fused carbon rings with different functional groups;

; includes cholesterol, aldosterone (hormone to regulate sodium in blood), and sex hormones, such as testosterone.

**Proteins;**  **Structure - Amino acids combine**

(1) 20 different amino acids, (2) Held together by *peptide bond*

protein (75 or more amino acids); contain elements: C, H, 0, and N

hemoglobin

**Proteins-** Function: used for structure (keratin, collagen, muscle) Forms nails, hair, hooves, etc.

**peptide bonds-** covalent bond between amino acids; # & order of amino acids in protein determines types of proteins ;used in muscle contraction; transporting Oxygen in blood steam; providing immunity; carryout chemical reactions

**Enzymes-** Involved in all metabolic processes; can speed reaction in digestion; synthesis of molecules; storage + release of energy; speeds up chemical reactions; enables reactions to occur in living cells-; proteins in living things which changes the rate of a chemical reaction; involved in most metabolic processes; may increases rate; digestion, synthesis of molecules, storing & releasing energy

**Nucleic Acids-** are polymers which are mad of sub-units called Nucleotides-

Types- Contain carbon, hydrogen, oxygen, nitrogen & phosphorus

**DNA** (deoxyribonucleic acid)- Forms the Genetic code ; stores information in the cell in the form of a code- it is a double stranded helix held together by hydrogen bonds; Structure: composed of polymers of *nucleotides*, which are made up of a phosphate, pentose sugar, and a nitrogenous base/ forms genes **sugar is deoxyribose**.

**RNA -**ribonucleic acid- It forms a copy of DNA for protein synthesis ; it is single- stranded

1. **ATP** (adenosine triphosphate):functions as energy carrier in cells due to two high-energy bonds. a nucleotide composed of adenine, ribose sugar, and three phosphate groups;

**Chemical Formulas**

1. Na + Cl -> NaCl
2. reactants are on the left; products are on the right
3. Must have the all of the chemicals in the same amounts on both sides of a balanced reaction

Compounds which have chemical formulas use *subscripts* to identify the atoms in the new formula. Do not balance the formula by changing these numbers. (already balanced)

C6H12O6 + O2 -> H2O + CO2

* List all the chemicals

Count the number of atoms on both side

Balance the formula by adding numbers in front of the formulas.

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